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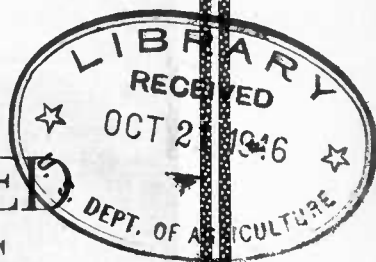
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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1179

FEEDING COTTONSEED PRODUCTS TO LIVESTOCK



IN REGIONS where much corn, stover, fodder, timothy, or other carbohydrate feed is used, it is important to use some feed that is high in protein, such as cottonseed meal.

Cottonseed meal stimulates the appetite of fattening animals and causes them to consume more feed and consequently to make greater gains.

Cottonseed cake or meal may be used satisfactorily as a supplemental feed for fattening beef cattle on pasture.

Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal furnishes as much digestible protein as 3 pounds of wheat bran. Like wheat bran, cottonseed meal is high in phosphorus.

For high-producing dairy cows, however, the addition of cottonseed meal to rations of the type mentioned renders them satisfactory only so far as the protein requirement is concerned.

Hogs may be fed cottonseed meal in limited quantities as a protein supplement.

Horses may be fed cottonseed products only in small quantities and then with great caution.

Procure prices on various grades of cottonseed meal or cake and choose the feed which supplies a pound of protein at the least cost.

FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

COTTONSEED PRODUCTS have been extensively fed to stock in the South for many years. More recently their use has become general in many sections outside the Cotton Belt. Demand from foreign countries is strong, although these products cost considerably more there than in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man.

Another reason, in addition to their high protein content, why cottonseed products are so important is their immense production. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been on the market during the last few years, but the average stockman has not received them with so much favor as cottonseed meal or linseed meal, partly because of their unknown value. These newer products, however, have some characteristics that give them value in livestock feeding.

COMPOSITION OF COTTONSEED PRODUCTS

Many cottonseed products, both concentrates and roughages, are used as livestock feeds. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly on the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cottonseed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, marketed by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

Untreated cottonseed contains a substance called gossypol, which is toxic to animals. This substance is made inactive by cooking the seed after the addition of water. Similarly, the cooking and expelling

¹Mr. Sheets left the Department in October 1934. Mr. Thompson died Oct. 6, 1924. The bulletin has been revised by specialists in the Animal Husbandry Division.

processes to which cottonseed meal is subjected in order to remove the oil are in large measure destructive to the toxic principle in the raw seed. The extent to which each step in the varied methods of manufacture of cottonseed oil and cottonseed meal affects the toxicity of the meal is not yet determined, and it is possible, that when this knowledge is obtained and applied, the meal can be fed economically in larger quantities than at present.

TABLE 1.—*Composition of cottonseed products*¹

[Pounds of nutrients in 100 pounds]

Product	Water	Ash	Crude protein	Carbohydrates		Fat (ether extract)
				Fiber	Nitrogen-free extract	
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Cottonseed.....	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
41 per cent protein.....	7.1	5.7	41.7	10.0	28.4	7.1
38.6 per cent protein.....	6.9	5.9	38.8	12.2	29.4	6.8
36 per cent protein.....	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed.....	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls.....	8.7	2.6	3.5	46.2	38.0	1.0

¹ Furnished by the Bureau of Chemistry and Soils, United States Department of Agriculture.

Cottonseed meal is a good source of potash and phosphorus, but is deficient in calcium. An adequate quantity of calcium is especially important to milking or nursing animals and to young stock, and may be supplied satisfactorily by legume hays or as a mineral supplement. There are indications that some nutritional failures attributed to cottonseed meal are the result of using it with poor-quality roughages, such as hulls or straw. A satisfactory ration using cottonseed meal as the concentrate should contain also certain nutritive elements which are supplied by such roughages as legume or other hays of good quality or by pasturage.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Cottonseed (uncrushed) was formerly used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes have greatly decreased the amount fed in the form of seed. Cottonseed products have largely taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble of this sort.

Cottonseed contains about 20 per cent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products: Linters or short fiber, 110 pounds; hulls, 514 pounds; cake or meal, 954 pounds; crude oil, 303 pounds; dirt and loss in manufacture, 119 pounds.

Cottonseed cake is made from the residue remaining after the oil has been extracted from the seed. Ordinarily the greater part of the

hulls is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of prime quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls gives the cake a dark appearance. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and it is better adapted for feeding alone or on the ground. Ocean freight rates also are lower for the cake than for the meal.

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread on the ground. If meal were used, the loss in feeding in this manner would be very large.

Many grades and classes of cottonseed products are sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows:

1. Cottonseed meal, prime quality. Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish, not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It shall be designated and sold according to its protein content. Cottonseed meal with 36 per cent of protein shall be termed "36 per cent protein cottonseed meal, prime quality," and higher grades similarly designated (as "43 per cent protein cottonseed meal, prime quality"), etc.

2. Cottonseed meal, off quality. Cottonseed meal not fulfilling the above requirements as to color, odor, and texture shall be graded "36 per cent protein cottonseed meal, off quality," and higher grades similarly designated.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cottonseed is the product obtained from the subjection of the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil and includes the entire cottonseed less the oil extracted.

Ground, cold-pressed cottonseed is the product obtained by grinding cold-pressed cottonseed.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content, and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton*

Cost of feed per ton	Per cent of protein in feeds										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein										
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
\$10.00	4.17	3.13	2.50	2.08	1.79	1.56	1.39	1.32	1.22	1.16	1.11
15.00	6.25	4.69	3.75	3.13	2.68	2.34	2.08	1.97	1.83	1.74	1.67
20.00	8.33	6.25	5.00	4.17	3.57	3.13	2.78	2.63	2.44	2.33	2.22
25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds

of the meal will be 6×6.25 , which is 37.50. This means that it is a good grade of meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15 , which is 38.62, meaning that it is a good grade of meal.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products*

Product	1 quart weighs—	1 pound measures—
	Pounds	Quarts
Cottonseed.....	0.8	1.3
Cottonseed meal.....	1.5	.7
Cottonseed hulls.....	.3	3.3

FATTENING CATTLE IN THE DRY LOT

Fattening or carbohydrate feeds should be fed in conjunction with roughages and supplemented with feeds rich in protein. In many of the fattening areas the protein supply is limited, and accordingly is one of the factors of most importance to the cattle feeder. When there is an abundance of legume hay, such as clover or alfalfa, and its market value is not excessive, it is perhaps unnecessary to supply any additional protein in the form of a meal or cake. However, when protein can be supplied more cheaply in the latter form, it may be advisable to replace part of the hay with a meal or cake.

Protein concentrates, such as cottonseed meal or cake, are used generally in rations in which straw, stovers, or silage makes up the roughage. In buying cottonseed products as a source of protein it is usually advisable to purchase the feed that will supply protein most cheaply. This can be easily determined if the percentage of protein and price per ton are known. For example, cottonseed meal having a protein content of 45 per cent and priced at \$25 a ton will supply protein more cheaply than 36 per cent meal at \$20 a ton. (Table 2.)

In many sections of the South there is a shortage of carbohydrate feeds (grains) for fattening purposes, and under these conditions considerable quantities of cottonseed hulls are fed in conjunction with cottonseed meal. This type of ration is more adaptable to cattle 2 years old and over, and for short feeding periods.

Suggested rations for fattening steers averaging 1,000 pounds in weight

RATION 1		RATION 3	
	Pounds		Pounds
Corn or barley (ground)-----	20	Kafir or other grain sorghums----	20
Mixed hay-----	10	Sorgo fodder-----	15
Cottonseed meal-----	3	Cottonseed meal or cake-----	4
RATION 2		RATION 4	
	Pounds		Pounds
Corn-----	18	Molasses-----	3
Mixed hay-----	5	Cottonseed hulls-----	25
Corn silage-----	20	Cottonseed meal-----	7
Cottonseed meal-----	4		

FATTENING CATTLE ON GRASS

Cottonseed products are used liberally as supplements in the fattening of cattle on grass. Cottonseed cake is frequently used as the sole supplemental feed, but more often cottonseed meal or cake is used in a mixture with corn or other grain. A desirable mixture for use as a supplement for cattle on grass is 8 parts by weight of corn or other grain and 2 parts of cottonseed meal or cake. Cattle fattened on grass with a supplement are usually allowed all the feed they will eat once a day in addition to grass. Usually cattle on pasture will not eat more than one-half the feed that would ordinarily be eaten in dry-lot feeding.

STOCK CATTLE

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to supply the necessary protein. It is especially valuable to use in connection with cheap roughages and silages. For stock cattle weighing from 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance most roughage rations properly. If legume hays, such as alfalfa or clover, constitute half or more of the roughage ration, there is little or no need of the use of cottonseed meal.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock cattle will eat should keep them in good, thrifty condition and cause them to make a satisfactory gain. The cost of wintering such cattle can usually be lessened by permitting them to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight

RATION 1		RATION 3	
	Pounds		Pounds
Corn (or sorgo) silage-----	25	Cottonseed hulls-----	15 to 20
Oat or wheat straw-----	Unlimited.	Grass hay-----	5
Cottonseed meal-----	$\frac{1}{2}$ to $1\frac{1}{2}$	Cottonseed meal-----	2

RATION 2		RATION 4	
	Pounds		Pounds
Corn (or sorgo) silage-----	25	Cottonseed cake-----	1 to $1\frac{1}{2}$
Oats or corn-----	2	Silage, to supplement winter	
Cottonseed meal-----	$\frac{1}{2}$	pastures-----	15 to 20
Straw or stover-----	Unlimited.		

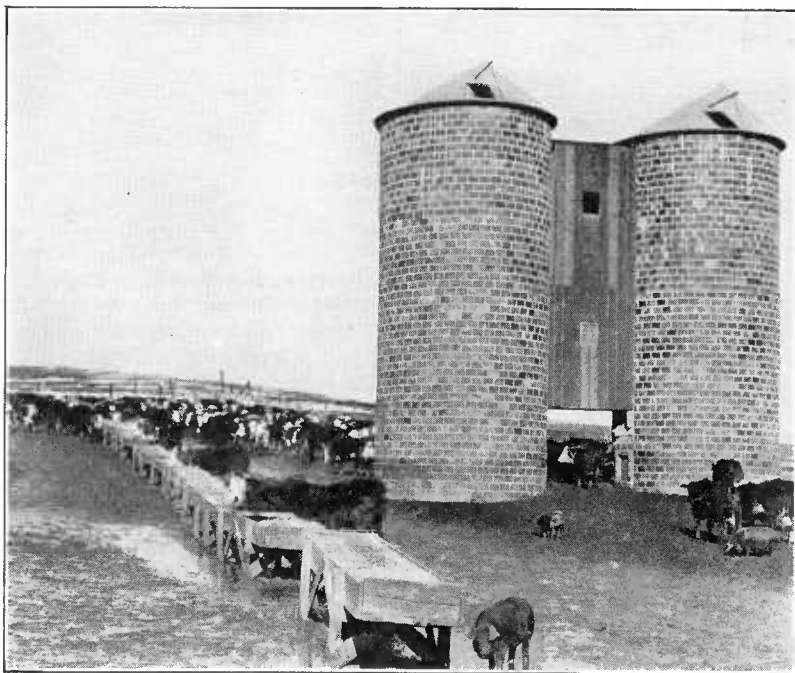


FIGURE 1.—Cottonseed meal and corn silage make a good feed combination for beef cattle. The meal supplies the protein which the silage lacks

BREEDING CATTLE

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to $1\frac{1}{2}$ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows is 25 to 30 pounds silage, from 1 to $1\frac{1}{2}$ pounds cottonseed meal or cake, and other roughage, such as stalks in the field, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef breeding cows averaging 1,000 pounds in weight

RATION 1		RATION 3	
	Pounds		Pounds
Corn silage.....	25 to 30	Grass hay or stover.....	18 to 20
Cereal straw or stover....	Unlimited.	Cottonseed meal or cake..	1½ to 2
Cottonseed meal.....	1 to 1½		
RATION 2		RATION 4	
	Pounds		Pounds
Corn (or sorgo) silage.....	25 to 30	Kafir (or milo) silage.....	30 to 35
Cottonseed meal.....	1 to 1½	Kafir or milo stover or ce- real straw.....	Unlimited.
Winter pasture.		Cottonseed meal or cake...	1½

DAIRY COWS

Cottonseed meal is a valuable feed for dairy cows. It is a relatively cheap source of protein, and can be used safely in such quantities as are needed to provide sufficient protein in the ration. In feeding cottonseed meal, however, certain precautions should be observed which apply in large measure to the feeding of any other high-protein concentrate. It should be fed with nicely cured hays, silage, pasture, or other green forage. If it is fed in this way, any reasonable quantity may be fed without injury to the cow. Harmful effects of rations containing cottonseed meal or other high-protein concentrate have been reported only when the roughage fed with the concentrate consisted of cottonseed hulls, wheat straw, or other inferior material.

When large quantities of cottonseed meal and a poor roughage are fed to dairy cows, the butter produced is hard, tallowy, and light in color; however, moderate quantities fed with good roughage do not result in butter of undesirable quality. Some kinds of feeds tend to result in a soft butter and the addition of some cottonseed meal to them in the ration results in a butter of satisfactory body.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily

RATION 1		RATION 3	
	Pounds		Pounds
Clover hay.....	10	Barley (or oat) hay.....	15
Corn (or sorgo) silage.....	35	Clover or alfalfa hay.....	5
Ground corn.....	3	Dried beet pulp.....	6
Wheat bran.....	2	Cottonseed meal.....	3
Cottonseed meal.....	2		
RATION 2		RATION 4	
	Pounds		Pounds
Roots (mangels).....	40	Corn (or sorgo) silage.....	35
Mixed hay.....	15	Grass hay.....	10
Corn-and-cob meal.....	3	Corn chops.....	3
Crushed barley.....	3	Cottonseed meal.....	4
Cottonseed meal.....	2½		

BULLS AND YOUNG STOCK

Bulls should receive a liberal quantity of protein-rich feeds. Cottonseed meal or cake may be used for the bull to the extent of from 2 to 4 pounds, with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. However, it may not be advisable to feed calves up to 6 months of age more than one-half pound per head per day. Calves at 1 year of age may be fed up to 2½ pounds.

HOGS

Cottonseed meal may be fed safely to hogs to the extent of 9 per cent of the total ration. The most economical method of feeding it, however, is to mix it with tankage, linseed meal, or alfalfa meal, and then not to exceed 50 per cent of such mixture.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES

The use of cottonseed meal for horses and mules is recommended only in limited quantities, and then care must be exercised in securing cottonseed meal of good quality.

Cottonseed meal has met with considerable disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn with apparently good results. Often it is used in connection with blackstrap molasses and grain.

The meal should be given to horses gradually at first and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quantities in a few cases, the best results may be obtained by limiting the amount to 1 pound per 1,000 pounds live weight and by giving special attention to the horses receiving the cottonseed meal.

Suggested rations for a 1,000-pound horse at medium work

RATION 1		RATION 3	
	Pounds		Pounds
Oats-----	12	Rolled barley-----	10
Timothy hay-----	12	Oat hay-----	12
Cottonseed meal-----	$\frac{3}{4}$	Cottonseed meal-----	1
RATION 2		RATION 4	
Shelled corn (dent)-----	8	Shelled corn (dent)-----	9
Wheat bran-----	4	Molasses (cane)-----	2
Mixed timothy and clover hay-----	10	Cowpea hay-----	6
Cottonseed meal-----	$\frac{3}{4}$	Sorgo fodder-----	6
		Cottonseed meal-----	1

SHEEP

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously



FIGURE 2.—Best carload of grade lambs from range ewes at the 1925 International Livestock Exposition. Fed and exhibited by Purdue University Agricultural Experiment Station. These lambs received a ration consisting, by weight, of seven parts of corn and one part of cottonseed meal fed with corn silage and clover hay

for this purpose (fig. 2). Cottonseed meal and cake have been used for fattening sheep with satisfactory results. In limited quantities they have been found one of the best types of protein-rich supplements for sheep.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements for a protein-rich concentrate, although these feeds are usually fed in connection with grains, forming from 10 to 15 percent of the grain ration.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed on other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for a 60-pound fattening lamb

RATION 1		RATION 3	
	Pounds		Pounds
Shelled corn.....	1. 0	Corn silage.....	1. 2
Grass hay.....	1. 0	Barley.....	1. 0
Cottonseed meal.....	. 25	Cottonseed meal.....	. 2
		Clover hay.....	. 6
RATION 2		RATION 4	
Shelled corn.....	1. 2	Barley.....	. 6
Alfalfa.....	. 4	Wet beet pulp.....	3. 0
Corn silage.....	. 6	Cottonseed meal.....	. 25
Cottonseed meal.....	. 2	Prairie hay.....	1. 0

POULTRY

Cottonseed meal is a fair poultry feed and may often be used economically in poultry rations in sections where it is produced. Vegetable protein feeds do not give as good results with poultry as animal-protein feeds and should always be supplemented with animal proteins as well as with minerals. The following mash for laying hens contains cottonseed meal supplemented with meat scraps and minerals:

	Pounds		Pounds
Yellow corn meal.....	35	Alfalfa leaf meal.....	5
Middlings.....	20	Bone meal.....	5
Cottonseed meal.....	10	Ground limestone.....	2
Meat scraps.....	12	Salt.....	1
Bran.....	10		

This mash should be fed with a good scratch ration which may be made up of the following ingredients, by weight: 2 parts yellow corn, 1 part wheat, and 1 part oats, or 2 parts corn and 1 part wheat.

The use of a ration containing more than 10 per cent of cottonseed meal may produce dark spots or blotches on the yolks of the eggs produced. This is not usually apparent in fresh eggs, but shows up after they have been kept in cold storage. The ration suggested, including both scratch and mash, furnishes only about 5 per cent cottonseed meal.

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING

For years feeders, of the Southwest particularly, have used from 1 to 2 pounds of cottonseed cake for feeding cows and steers on range in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 6 and 7 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has been found during more recent years to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted.³

There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten

³ Bureau of Animal Industry Bulletin 131, Beef Production in Alabama.

very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent on the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132 days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

The addition of the protein supplement increased the average daily gain 0.6 pound a day and reduced the total concentrates required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement*¹

Ration	Number of steers	Average daily gain	Feed per 100 pounds gain		
			Concentrates		Carbonaceous roughage
			Corn	Protein supplement	
		Pounds	Pounds	Pounds	Pounds
Corn and carbonaceous roughage.....	44	1.60	1,082	-----	522
Corn, protein supplement, and carbonaceous roughage.....	54	2.20	766	96	402

¹ Bulletin references: Illinois Experiment Station Bulletin 83; Indiana Experiment Station Bulletin 115; Nebraska Experiment Station Bulletins 90 and 93.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS

Many experiment stations have fed cottonseed meal to dairy cows in order to compare it with other protein feeds. A condensed statement of the results obtained is shown in Table 5.

TABLE 5.—*Results of feeding experiments showing relative value of cottonseed meal and other concentrates*

Station	Feed with which compared	Result
Florida.....	Velvetbeans in pod.....	Cottonseed meal worth from 1.5 to 2.5 times as much.
Maine.....	Gluten meal.....	Cottonseed meal superior.
Massachusetts.....	Do.....	Do.
Do.....	Ground soybeans.....	Practically the same.
Mississippi.....	Cottonseed.....	Cottonseed meal superior.
Do.....	Do.....	1 pound cottonseed meal is equal to 1.71 pounds velvetbeans.
Do.....	Velvetbeans in pod.....	3 pounds velvetbeans superior to 2 pounds cottonseed meal.
New Jersey.....	Equal parts wheat bran and dried brewers' grains.	4.5 pounds cottonseed meal are practically equal to 10 pounds of the other feeds.
Do.....	Ground soybeans.....	Practically the same.
Pennsylvania.....	Wheat bran.....	Cottonseed meal increased yield about 20 per cent.
South Carolina.....	Velvetbean meal.....	Cottonseed meal slightly superior.
Do.....	Wheat bran.....	1.5 pounds cottonseed meal slightly superior to 3 pounds wheat bran.
Tennessee.....	Ground soybeans.....	Practically the same.
U. S. Department of Agriculture.....	Fish meal.....	1 pound fish meal is equal to 1.24 pounds cottonseed meal.
Do.....	Peanut feed.....	1 pound cottonseed meal is equal to 1.36 pounds peanut feed.
Do.....	Velvetbean meal.....	1 pound cottonseed meal is equal to 1.54 pounds velvetbean meal.

Cottonseed meal is higher in protein than any other feed with which a comparison was made with the exception of fish meal. It will be noted in Table 5 that in no case did a feed containing a smaller percentage of protein than the cottonseed meal prove to be better than cottonseed meal. In this comparison the only feed showing results superior to those obtained from cottonseed meal was fish meal.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding*¹

Lot	Ration	Average daily gain	Daily ration of concentrates	Selling price of cattle	Profit per steer
		<i>Pounds</i>	<i>Pounds</i>		
Lot A.....	Pasture alone.....	1.52	3.31	\$3.66	\$2.86
Lot B.....	Pasture plus cottonseed cake.....	2.32		4.53	10.42

¹ From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound, or from 1.52 to 2.32 pounds. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a much greater profit than the cattle receiving grass alone.

COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGH-AGE FOR FATTENING LAMBS

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs*¹

Ration	Daily gain	Feed for 100 pounds gain	
		Concentrates	Hay
	Pounds	Pounds	Pounds
Corn.....	1.2	0.23	520
Timothy hay.....	1.0		
Corn.....	1.2	.30	463
Timothy hay.....	1.0		
Cottonseed (or linseed) meal.....	.2		

¹ From Ohio Experiment Station Bulletin 245, Minnesota Experiment Station Bulletin 31, and Indiana Experiment Station Bulletin 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal*¹

Ration	Initial weight	Daily gain	Feed for 100 pounds gain	
			Concentrates	Hay
	Pounds	Pounds	Pounds	Pounds
Ohio station, 112-day trial:				
Lot 1. 40 lambs—				
Linseed meal.....	0.2	0.30	397	497
Shelled corn.....	1.0			
Clover or alfalfa hay.....	1.5			
Lot 2. 40 lambs—				
Cottonseed meal.....	0.2	.31	388	486
Shelled corn.....	1.0			
Clover or alfalfa hay.....	1.5			
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal.....	0.2	.25	491	703
Shelled corn.....	1.1			
Clover hay.....	1.8			
Lot 2. 20 yearling wethers—				
Cottonseed meal.....	0.2	.24	511	748
Shelled corn.....	1.1			
Clover hay.....	1.8			

¹ From Ohio Experiment Station Bulletin 179 and Missouri Experiment Station Bulletin 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent on their relative prices and availability.